UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/922,122	08/03/2001	Hugues Marchand	G&C 30794.79-US-U1	7852

22462 7590 05/15/2008

GATES & COOPER LLP
HOWARD HUGHES CENTER
6701 CENTER DRIVE WEST, SUITE 1050
LOS ANGELES, CA 90045

EXAMINER	
SONG, MATTHEW J	

ART UNIT	PAPER NUMBER
1792	

MAIL DATE	DELIVERY MODE
05/15/2008	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Application Number: 09/922,122
Filing Date: August 03, 2001
Appellant(s): MARCHAND ET AL.

George H. Gates
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 2/14/2008 appealing from the Office action mailed 5/14/2007.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

No amendment after final has been filed.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

US 6,765,240	Tischler et al.	7-2004
US 5,874,747	Redwing et al.	2-1999

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

- Claims 1-2, 4-9, 15-17, 35 and 38 are rejected under 35 U.S.C. 102(e) as anticipated by Tischler et al (US 6,765,240).

Tischler et al disclose a semiconductor film of M*N formed on a substrate. Tischler et al also disclose using a silicon substrate (col 4, ln 50-60 and col 8, ln 10-35) and the M*N can be a single crystal material comprising a compositionally graded ternary metal nitride selected from the group consisting of AlGaN and InGaN (col 13, ln 1-5), this reads on appellant's single crystal graded gallium nitride layer having a substantially varying composition of a substantially continuous grade from an initial composition to a final composition.

With regard to the graded gallium nitride layer that has a net compressive stress, it is inherent to Tischler et al that the graded gallium nitride layer has net compressive stress because the differences in the lattice constant throughout the graded layer on a silicon substrate inherently cause compressive stress. Also, Tischler et al disclose that a single crystal has no defects from thermal coefficient of expansion differences, i.e. cracks (col 12, ln 45-65 and col 13, ln 1-5), which is further evidence that there is a net compressive stress because appellant discloses that crack free graded GaN has a net compressive stress, note page 8, lines 1-10 of the specification. Furthermore, appellant discloses that a larger amount of compressive strain is present using appellant's method than is found when using other methods (See page 8, lines 1-5 of appellant's specification); therefore appellant essentially admits that other methods produce compressive strain, but that appellant's method merely produces more compressive strain, which supports the examiner's inherency argument that the graded layer taught by Tischler et al has a net compressive strain. Also, appellant teaches the compressive strain is large enough to counterbalance the tensile stress induced by the cool down such that the net stress in the epitaxial

layer is compressive. (See page 8, lines 1-5 of appellant's specification). Appellant's disclosure further supports the examiner's inherency position because tensile stress, which is counterbalanced by the compressive stress which is induced by cooling down; however, Tischler et al are relied upon for teaching the compressively stressed material at high temperature. Thus, there is no tensile stress to counterbalance the compressive stress by cooling down.

Referring to claims 2, 4-9, and 35, these claims are product by process claims and are not limited to the manipulations of the recited steps, only the structure produced by the implied steps. Even though product-by-process claims are limited by and defined by the process, determination of the patentability is based on the product itself. If the product in the product by process claim is the same or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process (MPEP 2113). Tischler et al disclose a semiconductor film comprising all of the claimed structural features of the product.

Referring to claim 15, Tischler et al disclose forming microelectronic structures on the M*N, which include LEDS, lasers, transistors etc.; this reads on appellant's additional layer disposed on the graded layer.

Referring to claim 16-17, Tischler et al disclose the M*N material may be doped with Si and the M*N material may be an AlGaInN compositionally graded compound (col 12, ln 30-45 and col 9, ln 1-15); this reads on appellant's other element of silicon or indium.

Referring to claim 38, Tischler et al disclose the GaN material has no defects from thermal coefficient of expansion difference; this reads on appellant's graded gallium nitride having a net stress below a stress required for crack generation in the graded gallium nitride layer because the material contains no defects, including cracks.

- Claims 11-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tischler et al (US 6,765,240) as applied to claim 1 above, and further in view of Redwing et al (US 5,874,747).

Tischler et al teach all of the limitations of claim 11, as discussed previously for claim 1, except Tischler et al do not teach that initial composition comprises substantially at least 20% aluminum composition.

In a method of making gallium nitride, note entire reference, Redwing et al teach the quality of a GaN layer grown on a lattice mismatched substrate such as SiC or Si is greatly improved when a buffer or transition layer is grown on the substrate prior to growth of the GaN layer (col 4, ln 60-65). Redwing et al also teach a buffer structure which eliminates cracking comprising a compositionally graded (Al, Ga)N buffer layer between a substrate and a GaN epi-layer. Redwing et al also teach using a graded buffer layer gradually varies the lattice constant and thermal expansion coefficient from that of AlN to that of GaN (col 18, ln 35 to col 19, ln 25). Redwing et al also teach using an AlGaN buffer where the Al composition is graded from 1 at the substrate interface to 0 at the GaN interface (col 18, ln 60 to col 19, 10 and col 24, ln 55-67) to eliminate cracking of GaN epi-layers; this clearly suggests appellant's initial composition is at least 20% aluminum composition and the final composition comprises substantially less than a 20% aluminum composition.

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Tischler et al by using an initial composition rich in Al and a final

composition with no Al, as suggested by Redwing et al, to produce a GaN layer free of cracking by reducing lattice mismatch using a graded buffer layer.

Referring to claims 12-14, the combination of Tischler et al and Redwing et al teaches an initial composition of AlN and a final composition of GaN; this clearly suggests appellant's initial composition is at least 20% aluminum composition and the final composition comprises substantially less than a 20% aluminum composition.

(10) Response to Argument

Arguments directed to claims 1-2, 4-9, 15-17, 35 and 38

The primary issue to resolve is whether Tischler et al.'s silicon substrate and graded epitaxial layer would inherently possess a net compressive stress. The Examiner's position is that Tischler et al.'s silicon substrate and graded epitaxial inherently has a net compressive stress because the methods of forming the structure is similar to appellant's method of formation and based on appellant's disclosure of the properties of a net compressive stress the epitaxial layer. Also, Tischler et al.'s epitaxial layer is graded, thus, has a lattice mismatch which appellant also uses to form compressive stress. Appellant also discloses that compressive strained films do not crack, and Tischler et al.'s epitaxial layer is also crack free. It should also be noted that the Examiner's rejection is based on the intermediate product taught by Tischler et al. Tischler et al. teach a silicon substrate and a graded epitaxial layer formed thereon, then the silicon substrate is removed after growth to produce a free standing epitaxial layer. The rejection is based on the structure taught by Tischler et al. prior to removing the silicon substrate.

Appellant's argument that Tischler et al. would not inherently have a net compressive stress because the substrate is present only at the growth temperature (or close to it) is noted but not found persuasive. (See pg 5 of the brief). Appellant alleges that removing the substrate at high temperature eliminates the problem of thermal expansion mismatch between the substrate and the epitaxial layers, so it is expected that a free standing M*N film are stress free; however, appellant's invention is directed to a conventional film stack. First, this argument is not persuasive because removing the film at high temperature does not change the relationship of thermal expansion coefficients. The effect might be less but the epitaxial layer will still be subjected to stress because of the different thermal expansion coefficients of the substrate and the epitaxial layer. Second, Tischler et al. do teach that the substrate can be removed at more than 100°C below the growth temperature, preferably within 300°C; thus some added compressive stress would have resulted from the cool down to the removal temperature. Third, Appellant discloses the tensile stress is induced by the cool down procedure (See page 8, lines 1-5 of appellant's specification). Tischler et al. teach the silicon substrate and graded layer present at the growth temperature without a cool down process; therefore, the tensile stress which needs to be counterbalanced by the compressive stress is not induced since there is no cool down process; thus, there is inherently a net compressive stress. Fourth, Appellant discloses compressively strained films do not crack. (See page 8, line 5 of appellant's specification). Tischler et al. teach a substantially defect free (crack free because cracks are a defect) epitaxial M*N layer; thus the epitaxial layer inherently has a net compressive stress. Finally, Appellant achieves the claimed net compressive stress by varying composition continuously between the initial composition and the final composition without any interruption in precursor supply, and Appellant also discloses

this method produces a larger amount of compressive strain than found when using other methods. (See page 7, line 28 to page 8, line 3). Similarly, Tischler et al. teach ternary species of precisely graded AlGaN by controlling the composition by the gas phase composition during growth (column 7, lines 10-20 and claim 6). Therefore, a similar method is expected to produce a film having a net compressive stress, and Appellant discloses that other methods also are known to produce compressive stress.

Appellant's argument that the GaN layer deposited on a Si substrate has a net compressive stress after the structure has cooled down and the free-standing GaN layer taught by Tischler et al. should be stress free is noted but not found persuasive. First, deposition at a high temperature is still expected to produce a compressive stress because of the relationship between the thermal expansion coefficients and lattice constants of the epitaxial layer and the substrate. Second, Appellant does not address Tischler et al.'s teaching that removal of the substrate is typically conducted within 100°C of the growth temperature or at a temperature more than 100°C below the growth temperature. (column 8, lines 30-45). Therefore, Tischler et al. do teach cooling the structure after growth and prior to removal; thus, the structure would inherently have had a net compressive stress because appellant also teaches compressively strained films do not crack and Tischler et al. teach an epitaxial layer which is defect free, where cracks would be a defect that are not present in Tischler et al.'s epitaxial layer (See page 8, line 5 of appellant's specification and column 5, lines 10-37 of Tischler).

Appellant's argument that nothing in appellant's paragraph [0025] supports the conclusion that there is a net compressive stress in Tischler et al.'s intermediate product at the growth temperature is noted but not found persuasive. (See pg 7 of the brief). First, the Examiner

admits that the Examiner relies on Appellant's disclosure for providing the rationale for establishing inherency. However, the reliance is entirely based to show that an inherent feature is present, not as a teaching of prior art; thus the use of Appellant's disclosure is proper. Second, Appellant merely alleges that nothing in Appellant's paragraph [0025] supports the conclusion that there is a net compressive stress; however, the Examiner has clearly provide ample rationale in support of inherency, as discussed previously. Also, Appellant does not address the Examiner's position that the epitaxial layer is defect free after cooling 300°C from the growth temperature, which further supports the Examiner's inherency position. Appellant merely directs the arguments to the intermediate structure at the growth temperature. Appellant has not met the burden of showing an unobvious difference as required by MPEP 2112 after the Examiner presented reasoning tending to show inherency in the substantially identical products.

In summary, Tischler et al teach a graded epitaxial layer formed on a silicon substrate, and the Examiner has provided multiple rationales based on Appellant's disclosure which supports the Examiner's inherency position. Appellant's arguments are not persuasive and fail to rebut the Examiner position of inherency, as required by MPEP 2112. Also, Appellant fails to address Tischler et al.'s teachings of cooling the grown layer up to 300°C below the growth temperature and still producing a defect free epitaxial material, which based on Appellant's disclosure requires a net compressive stress. (See page 8, lines 1-5 of Appellant's specification).

Arguments directed to claims 16-17

Appellant's argument that doping does not teach or suggest introducing one other element into the growth chamber for the graded gallium nitride layer causing no abrupt variations in the varying composition of the graded gallium nitride layer, wherein the other

element is silicon is noted but not found persuasive. First, Tischler et al. teach a graded AlGaN or InGaN, and the material is doped with silicon. (See column 13, lines 1-10). Second, Tischler et al. teach doping during the growth to yield an n-type doping. (See column 8, lines 45-67). Tischler et al. do not teach doping with abrupt variations in the varying composition, thus, implicitly teaches avoiding abrupt variations. Finally, N-type doping of the M*N material during growth with Si, as taught by Tischler et al. in column 9-15, would require uniform doping to achieve uniform effect because if the dopant abruptly changes in the composition then the device would not function properly.

Arguments directed to claim 38

Tischler et al. teach a structure similar to appellant's claimed structure, as discussed previously regarding claim 1. Therefore, because Tischler et al. teach a defect free (crack free) epitaxial material, the net stress is below the stress required for crack generation since no cracks are formed.

Arguments directed to claims 2, 4-9, 11-15, and 35

Appellant does not argue these claims separately and claims 2, 4-9, 11-15 and 35 stand or fall with claim 1, which is discussed above.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner’s answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

/Matthew Song/

Matthew Song

Conferees:

/Michael Kornakov/

Michale Kornakov

Supervisory Patent Examiner, Art Unit 1792

/Kathryn Gorgos/

Kathryn Gorgos

Appeals Specialist